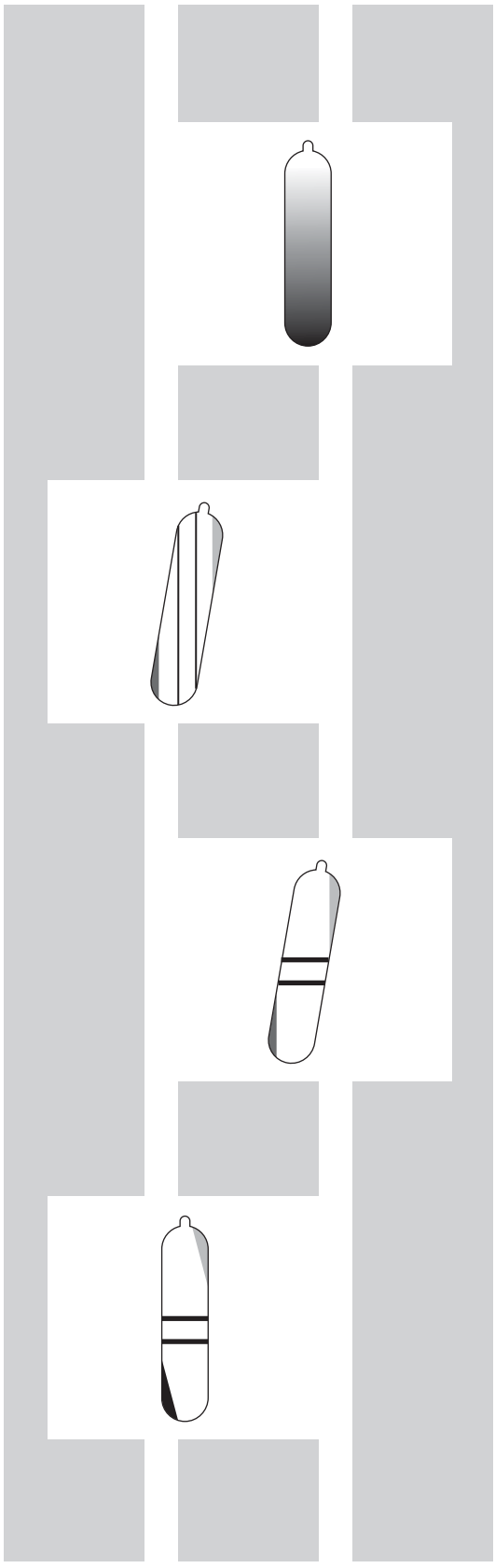
TL-TB-013E
September 2007



TLN-100 Rotor

Used In Beckman Coulter Optima™ MAX-XP, MAX, MAX-E, TL, TLX, and TL-100 Tabletop Ultracentrifuges

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Produced in the U.S.A.

SAFETY NOTICE

This safety notice summarizes information basic to the safe use of the rotor described in this manual. The international symbol displayed above is a reminder to the user that all safety instructions should be read and understood before operation or maintenance of this equipment is attempted. When you see the symbol on other pages throughout this publication, pay special attention to the specific safety information presented. Observance of safety precautions will also help to avoid actions that could damage or adversely affect the performance of the rotor. This rotor was developed, manufactured, and tested for safety and reliability as part of a Beckman Coulter ultracentrifuge/rotor system. Its safety or reliability cannot be assured if used in a centrifuge not of Beckman Coulter's manufacture or in a Beckman Coulter ultracentrifuge that has been modified without Beckman Coulter's approval.

Handle body fluids with care because they can transmit disease. No known test offers complete assurance that such fluids are free of micro-organisms. Some of the most virulent—Hepatitis (B and C) viruses, HIV (I–V), atypical mycobacteria, and certain systemic fungi—further emphasize the need for aerosol protection. Handle other infectious samples according to good laboratory procedures and methods to prevent spread of disease. Because spills may generate aerosols, observe proper safety precautions for aerosol containment. Do not run toxic, pathogenic, or radioactive materials in this rotor without taking appropriate safety precautions. Biosafe containment should be used when Risk Group II materials (as identified in the World Health Organization *Laboratory Biosafety Manual*) are handled; materials of a higher group require more than one level of protection.

The rotor and accessories are not designed for use with materials capable of developing flammable or explosive vapors. Do not centrifuge such materials in nor handle or store them near the ultracentrifuge.

Although rotor components and accessories made by other manufacturers may fit in the TLN-100 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the TLN-100 rotor may void the rotor warranty and should be prohibited by your laboratory safety officer. Only the components and accessories listed in this publication should be used in this rotor.

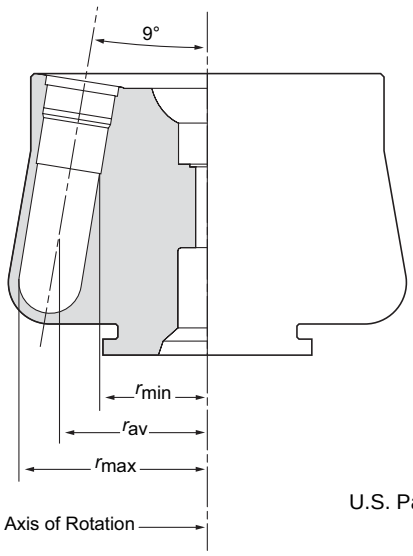
Make sure that filled containers are loaded symmetrically into the rotor and that opposing tubes are filled to the same level with liquid of the same density. Make sure that cavities in use have the proper spacers and/or floating spacers inserted before installing the rotor lid.

If disassembly reveals evidence of leakage, you should assume that some fluid escaped the rotor. Apply appropriate decontamination procedures to the centrifuge and accessories.

Never exceed the maximum rated speed of the rotor and labware in use. Refer to the section on RUN SPEEDS, and derate the run speed as appropriate.

Do not use sharp tools on the rotor that could cause scratches in the rotor surface. Corrosion begins in scratches and may open fissures in the rotor with continued use.

TLN-100 ROTOR



U.S. Pat. Nos. 4,102,490, 4,290, 550
Japanese Pat. No. 1,469,154

SPECIFICATIONS

Maximum speed	100 000 rpm
Density rating at maximum speed	1.7 g/mL
Relative Centrifugal Field* at maximum speed	
At r_{max} (40.2 mm)	450 000 × *g*
At r_{av} (31.6 mm)	354 000 × *g*
At r_{min} (23.1 mm)	259 000 × *g*
k factor at maximum speed	14
Conditions requiring speed reductions	see RUN SPEEDS
Number of tube cavities	8
Available tubes	see Table 1
Nominal tube dimensions (largest tube)	13 × 38 mm
Nominal tube capacity	3.9 mL
Nominal rotor capacity	31.2 mL
Approximate acceleration time to maximum speed (fully loaded)	3 1/2 min
Approximate deceleration time from maximum speed (fully loaded)	2 1/2 min
Weight of fully loaded rotor	0.9 kg (2.0 lb)
Rotor material	titanium

* Relative Centrifugal Field (RCF) is the ratio of the centrifugal acceleration at a specified radius and speed ($r\omega^2$) to the standard acceleration of gravity (g) according to the following formula:

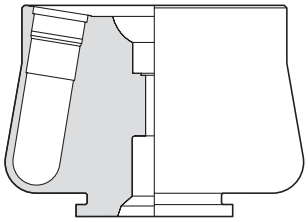
$$RCF = \frac{r\omega^2}{g}$$

where r is the radius in millimeters, ω is the angular velocity in radians per second (2π RPM /60), and g is the standard acceleration of gravity (9807 mm/s^2). After substitution:

$$RCF = 1.12\, r \left(\frac{RPM}{1000}\right)^2$$

DESCRIPTION

This Beckman Coulter rotor has been manufactured in a registered ISO 9001 or 9002 facility for use with the appropriately classified Beckman Coulter ultracentrifuge.



The TLN-100, rated for 100 000 rpm, is a near-vertical tube rotor with a tube angle of 9 degrees from the axis of rotation. The rotor can centrifuge up to eight tubes and is used in Beckman Coulter Optima™ MAX, MAX-XP, MAX-E, TL, TLX, and the TL-100 tabletop ultracentrifuges. The slight angle of this rotor significantly reduces run times from a more conventional fixed angle rotor (with a tube angle of 20 to 45 degrees), while allowing components that do not band under separation conditions to either pellet to the bottom or float to the top of the tube.

The rotor is made of titanium and is finished with black polyurethane paint. A tube spacer and rotor plug hold each tube in the rotor, and a plug gasket forms a closure around each plug. Rotor plugs and spacers are anodized aluminum.

The ultracentrifuge identifies rotor speed during the run by means of a magnetic speed sensor in the instrument chamber and magnets on the bottom of the rotor. This overspeed protection system ensures that the rotor does not exceed its maximum permitted speed.

See the Warranty at the back of this manual for warranty information.

PREPARATION AND USE

Specific information about the TLN-100 rotor is given here. Information common to this and other rotors is contained in Rotors and Tubes for Tabletop Preparative Ultracentrifuges *(publication TLR-IM), which should be used together with this manual for complete rotor and accessory operation. Publication TLR-IM is included in the literature package shipped with the rotor.*

NOTE

Although rotor components and accessories made by other manufacturers may fit in the TLN-100 rotor, their safety in this rotor cannot be ascertained by Beckman Coulter. Use of other manufacturers' components or accessories in the rotor may void the rotor warranty and should be prohibited by your laboratory safety officer. Only the components and accessories listed in this publication should be used in this rotor.

PRERUN SAFETY CHECKS

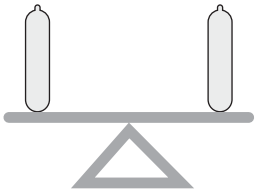
Read the Safety Notice page at the front of this manual before using the rotor.

1. Inspect the rotor plugs, gaskets, spacers, and plunger mechanism for damage—the high forces generated in this rotor can cause damaged components to fail.
2. Use only tubes and accessories listed in Table 1.
3. Check the chemical compatibilities of all materials used (refer to Appendix A in *Rotors and Tubes)*.

ROTOR PREPARATION

For runs at other than room temperature, refrigerate or warm the rotor beforehand for fast equilibration.

1. Lightly but evenly lubricate metal threads with Spinkote™ lubricant (306812).
2. Set the rotor into the rotor vise, which should be attached to a rigid surface.



3. Load the plugged or sealed tubes symmetrically into the rotor (see page 8 for tube information). If fewer than eight tubes are being run, they must be arranged symmetrically in the rotor (see Figure 1). *Opposing tubes must be filled to the same level with liquid of the same density.*

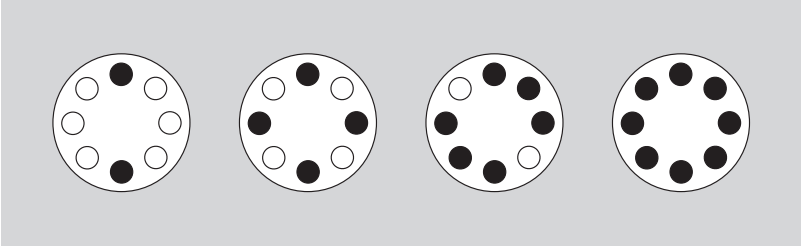
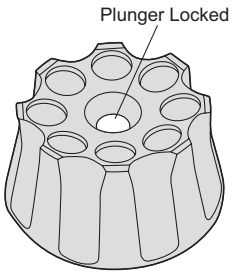


Figure 1. Arranging Tubes in the Rotor. Two, four, six, or eight tubes can be centrifuged per run if they are arranged in the rotor as shown.

4. Use the required spacers (see Table 1) to complete the loading operation.
5. Insert a rotor plug (white gasket-end down) over each spacer and screw it in.
6. Using the plug adapter (976959) and torque wrench (858121), torque each rotor plug to 13.6 N•m (120 in.-lb). *To avoid stripping the plugs, apply downward pressure to the plug adapter while tightening the plugs*. Do not overtighten plugs.

OPERATION



1. Use an absorbent towel to wipe off condensation from the rotor, then carefully place the rotor on the drive hub.
2. Lock the rotor in place by gently pressing the plunger down until you feel it click. When you remove your finger, the plunger will remain flush with the rotor body if it is properly engaged. If the plunger pops up, repeat the procedure. (The Optima MAX, MAX-XP, and MAX-E ultracentrifuges automatically secure the rotor to the drive shaft without the need for engaging the plunger.)

CAUTION

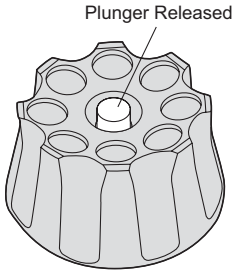
In all ultracentrifuge models except the Optima MAX, MAX-XP, and MAX-E, it is very important to lock the rotor in place before beginning the run to ensure that the rotor remains seated during centrifugation. Failure to lock the rotor in place before beginning the run may result in damage to both rotor and instrument.

3. Refer to the instrument instruction manual for ultracentrifuge operation.
4. For additional operating information, see the following:
   - RUN TIMES, page 9, for using *k* factors to adjust run durations.
   - RUN SPEEDS, page 10, for information about speed limitations.
   - SELECTING CsCl GRADIENTS, page 12, for methods to avoid CsCl precipitation during centrifugation.

REMOVAL AND SAMPLE RECOVERY

CAUTION

If disassembly reveals evidence of leakage, you should assume that some fluid escaped the rotor. Apply appropriate decontamination procedures to the centrifuge and accessories.



1. To release the plunger at the end of the run, gently press it down until you feel it click. When you remove your finger the plunger will pop up to its released position.
2. Remove the rotor from the ultracentrifuge and place it in the rotor vise.
3. Remove the rotor plugs, taking care to apply downward pressure on the plug adapter to avoid stripping the plugs.
4. Use a tube removal tool to remove the spacers and tubes.

TUBES AND ACCESSORIES

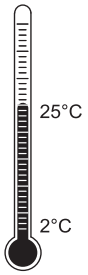
The TLN-100 rotor uses tubes and accessories listed in Table 1. Be sure to use only those items listed, and to observe the maximum speed limits shown. Refer to Appendix A in *Rotors and Tubes* for information on the chemical resistances of tube and accessory materials.

Table 1. Available Tubes for the TLN-100 Rotor.
Use only the items listed here and observe maximum fill volumes and speed shown.

Tube			Required Accessory		Max. Speed/ RCF/ *k* Factor
Dimensions and Volume	Description	Part Number	Description	Part Number	
13 × 38 mm 3.9 mL	Quick-Seal polyallomer	358980 (pkg/50)	black aluminum spacer	342883 (pkg/8)	100 000 rpm 450 000 × *g* 14
13 × 33 mm 3.3 mL	OptiSeal*	361627 (pkg/56)	gold aluminum spacer	362198 (pkg/2)	100 000 rpm 450 000 × *g* 14

*Includes disposable plastic plugs.

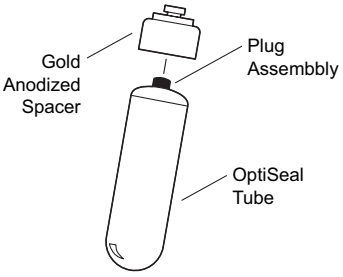
Temperature Limits



- Plastic tubes have been centrifuge tested for use at temperatures between 2 and 25°C. For centrifugation at other temperatures, pretest tubes under anticipated run conditions.
- If plastic containers are frozen before use, make sure that they are thawed to at least 2°C prior to centrifugation.

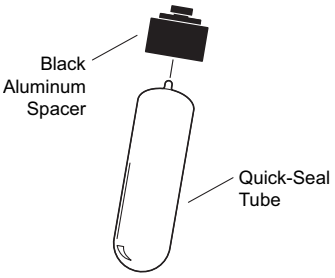
OptiSeal™ Tubes

OptiSeal tubes come with plastic plugs and can be quickly and easily prepared for use. With the tube spacer in place, the *g* force during centrifugation ensures a tight, reliable seal that protects your samples.



- Place the tubes in the rack and fill each tube to the base of the stem, leaving no fluid in the stem. Overfilling the tube can cause spillage when the plug is inserted or can compromise seal integrity. However, too much air can cause excessive tube deformation, disrupting gradients and sample bands.
- Refer to *Using OptiSeal™ Tubes* (publication IN-189), included in each box of tubes, for detailed information on the use and care of OptiSeal tubes.

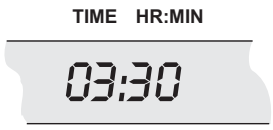
Quick-Seal® Tubes



Quick-Seal tubes must be sealed prior to centrifugation. These tubes are heat sealed and do not need caps; however, spacers are required on top of the tubes when they are loaded into the rotor.

- Fill Quick-Seal tubes leaving a *small* bubble of air at the base of the neck. Do not leave a large air space—too much air can cause excessive tube deformation.
- Refer to *Rotors and Tubes* for detailed information on the use and care of Quick-Seal tubes.

RUN TIMES



The *k* factor of the rotor is a measure of the rotor's pelleting efficiency. (Beckman Coulter has calculated the *k* factors for all of its preparative rotors at maximum rated speed and using full tubes.) The *k* factor is calculated from the formula:

$$k = \frac{\ln(r_{max} / r_{min})}{\omega^2} \times \frac{10^{13}}{3600} \qquad (1)$$

where ω is the angular velocity of the rotor in radians per second ($\omega = 0.105 \times \text{rpm}$), r_{max} is the maximum radius, and r_{min} is the minimum radius.

After substitution:

$$k = \frac{(2.533 \times 10^{11}) \ln(r_{max} / r_{min})}{\text{rpm}^2} \quad (2)$$

Use the *k* factor in the following equation to estimate the run time *t* (in hours) required to pellet particles of known sedimentation coefficient *s* (in Svedberg units, *S*).

$$t = \frac{k}{s} \quad (3)$$

Run times can be estimated for centrifugation at less than maximum speed by adjusting the *k* factor as follows:

$$k_{adj} = k \left(\frac{100\,000}{\text{actual run speed}} \right)^2 \quad (4)$$

Run times can also be estimated from data established in prior experiments if the *k* factor of the previous rotor is known. For any two rotors, a and b:

$$\frac{t_a}{t_b} = \frac{k_a}{k_b} \quad (5)$$

For more information on *k* factors see *Use of* k *Factor for Estimating Run Times from Previously Established Run Conditions (*publication DS-719).

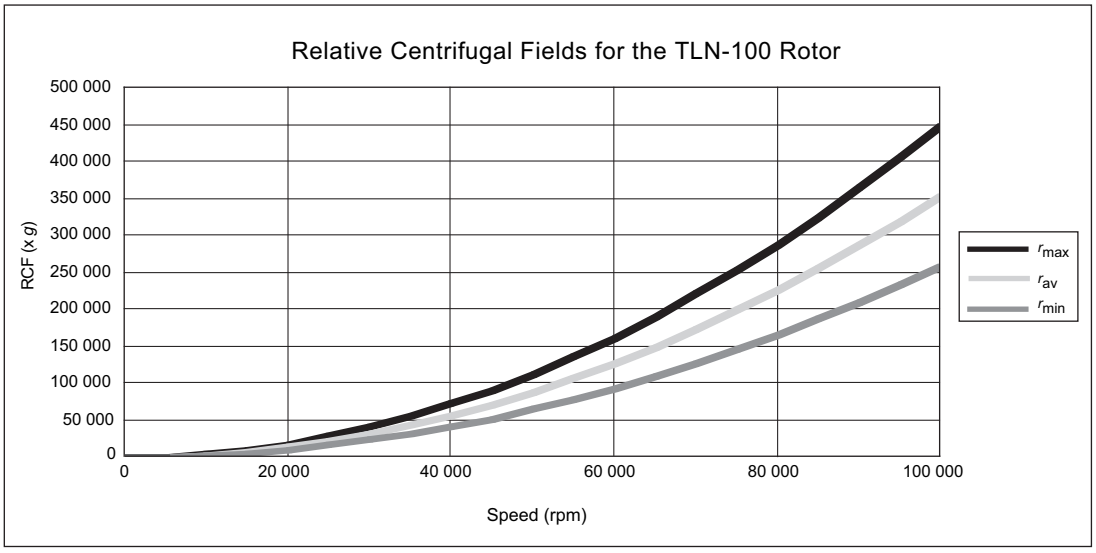
RUN SPEEDS

The centrifugal force at a given radius in a rotor is a function of speed. Comparisons of forces between different rotors are made by comparing the rotors' relative centrifugal fields (RCF). When rotational speed is adjusted so that identical samples are subjected to the same RCF in two different rotors, the samples are subjected to the same force. The RCF at a number of rotor speeds is provided in Table 2.

Table 2. Relative Centrifugal Fields for the TLN-100 Rotor.
Entries in this table are calculated from the formula
$RCF = 1.12r\ (RPM/1000)^2$ and then rounded to three significant digits.

Rotor Speed (rpm)	Relative Centrifugal Field (× *g*)			*k* Factor*
	At r_{max} (40.2 mm)	At r_{av} (31.6 mm)	At r_{min} (23.1 mm)	
100 000	450 000	354 000	259 000	14
95 000	406 000	319 000	233 000	15
90 000	365 000	287 000	210 000	17
85 000	325 000	256 000	187 000	19
80 000	288 000	227 000	166 000	22
75 000	253 000	199 000	146 000	25
70 000	221 000	173 000	127 000	28
65 000	190 000	150 000	109 000	33
60 000	162 000	127 000	93 100	38
55 000	136 000	107 000	78 300	46
50 000	113 000	88 500	64 700	55

*Calculated for all Beckman Coulter preparative rotors as a measure of the rotor's relative efficiency in pelleting sample in water at 20°C.



Speeds must be reduced under the following circumstances:

1. If nonprecipitating solutions more dense than 1.7 g/mL are centrifuged, the maximum allowable run speed must be reduced according to the following equation:

$$\text{reduced maximum speed} = (100\,000 \text{ rpm}) \sqrt{\frac{1.7 \text{ g/mL}}{\rho}} \qquad (6)$$

   where ρ is the density of the tube contents. This speed reduction will protect the rotor from excessive stresses due to the added tube load.

2. *Further speed limits must be imposed* when CsCl or other self-forming-gradient salts are centrifuged, as equation (6) does not predict concentration limits/speeds that are required to avoid precipitation of salt crystals. Precipitation during centrifugation would alter the density distribution of CsCl and this would change the position of the sample bands. Figures 2 and 3, together with the description and examples below, show how to reduce run speeds when using CsCl gradients.

SELECTING CsCl GRADIENTS

Precipitation during centrifugation would alter density distribution, and this would change the position of the sample bands. Curves in Figures 2 and 3 are provided up to the maximum rated speed of the rotor.

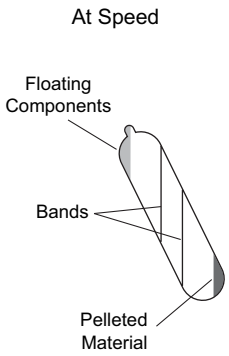
NOTE

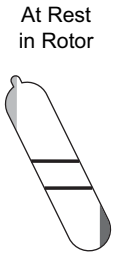
The curves in Figures 2 and 3 are for solutions of CsCl salt dissolved in distilled water only. If other salts are present in significant concentrations, the overall CsCl concentration may need to be reduced.

Rotor speed is used to control the slope of a CsCl density gradient, and must be limited so that CsCl precipitation is avoided. Speed and density combinations that intersect on or below the curves in Figure 3 ensure that CsCl will not precipitate during centrifugation in the TLN-100 rotor. Curves are provided at two temperatures: 20°C (black curves) and 4°C (gray curves).

The reference curves in Figure 3 show gradient distribution at equilibrium. Each curve in Figure 3 is within the density limits allowed for the TLN-100 rotor: each curve was generated for a single run speed using the maximum allowable homogeneous CsCl densities (one for each fill level) that avoid precipitation at that speed. (The gradients in Figure 3 can be generated from step or linear gradients, or from homogeneous solutions. But the total amount of CsCl in solution must be equivalent to a homogeneous solution corresponding to the concentrations specified in Figure 2.) Figure 3 can also be used to approximate the banding positions of sample particles.

TYPICAL EXAMPLES FOR DETERMINING CsCl RUN PARAMETERS





Example A: Knowing homogeneous CsCl solution density (1.70 g/mL) and approximate particle buoyant densities (1.70 and 1.68 g/mL), where will particles band?

1. In Figure 2, find the curve that corresponds to the required run temperature (20°C). The maximum allowable rotor speed is determined from the point where this curve intersects the homogeneous CsCl density (79 000 rpm).

2. In Figure 3, sketch in a horizontal line corresponding to each particle's buoyant density and find the density gradient curve corresponding to the above speed (79 000 rpm).

3. Mark the point in the figure where each particle density intersects the curve corresponding to the run speed (79 000 rpm) and temperature (20°C).

4. Particles will band at these marked points across the tube diameter (lower axis of Figure 3) at equilibrium during centrifugation. After centrifugation the bands will reorient (upper axis).

In this example, the particles will band along this curve about half of the way from the right edge of the figure. Using the lower horizontal axis, it can be estimated that these particles will about 1 mm apart at equilibrium during centrifugation.

Example B: Knowing particle buoyant densities (1.59 and 1.61 g/mL), how do you get the best separation? Assume 20°C operation.

1. In Figure 3, sketch in a horizontal line corresponding to each particle's buoyant density.

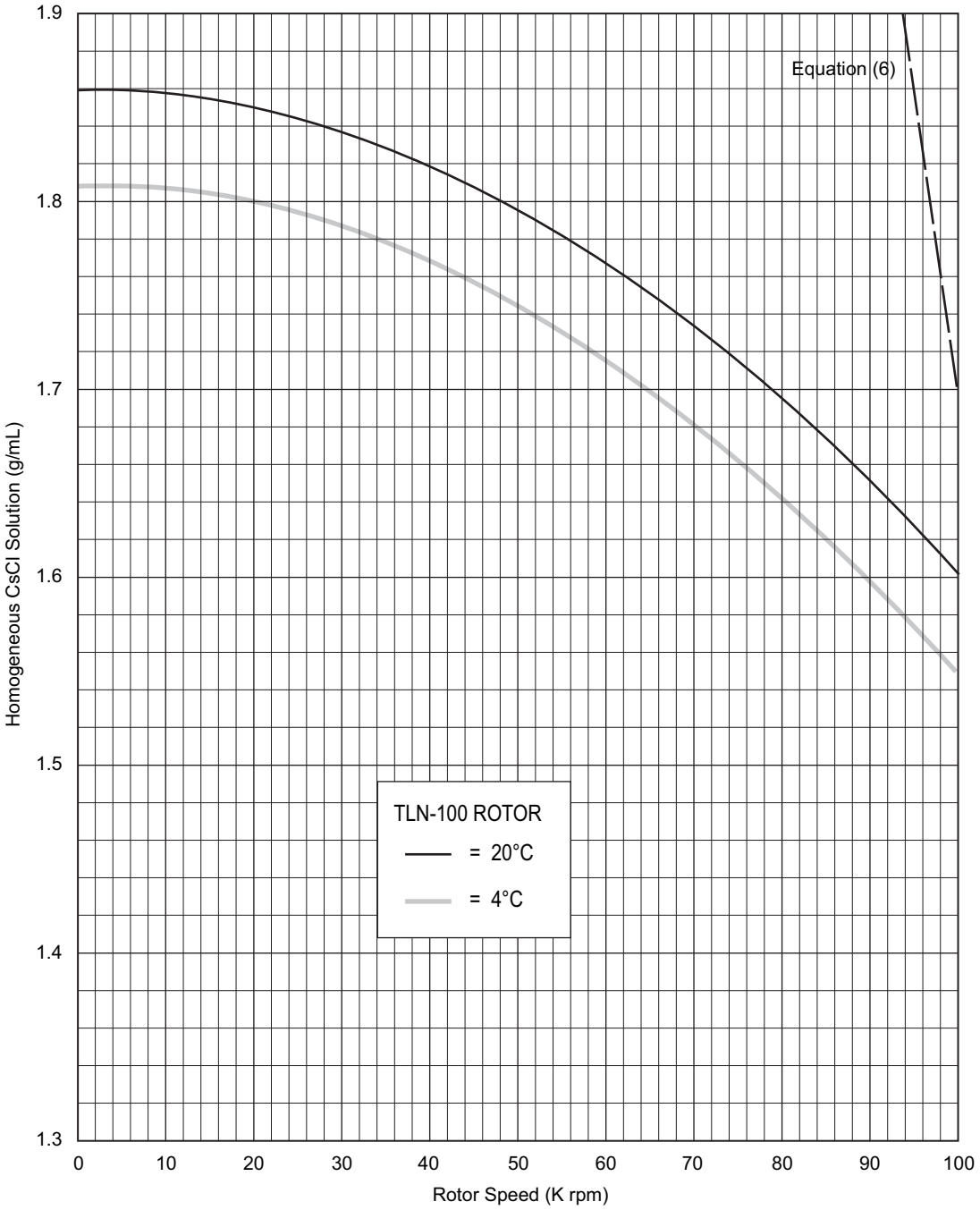


Figure 2. Precipitation Curves for the TLN-100 Rotor. Using combinations of rotor speeds and homogeneous CsCl solution densities that intersect on or below these curves ensures that CsCl will not precipitate during centrifugation. The dashed line is a representation of equation (6), and is shown here to illustrate the inability of that equation to guard against CsCl precipitation.

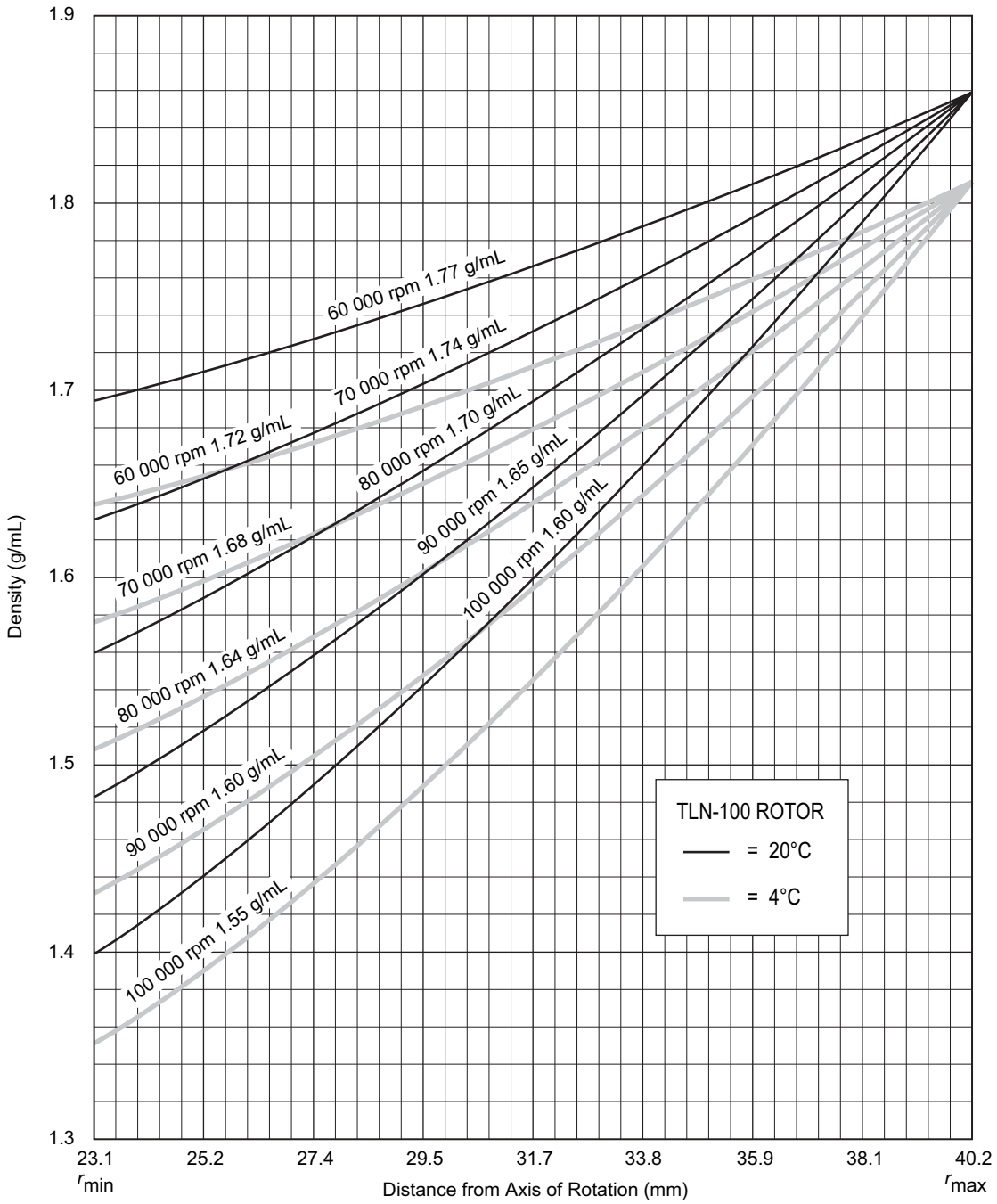


Figure 3. CsCl Gradients at Equilibrium for the TLN-100 Rotor. Centrifugation of homogeneous CsCl solutions at the maximum allowable speeds (from Figure 2) results in gradients presented here. The homogeneous CsCl solution density used to generate each curve is printed along the curve.

2. Select the curve that gives the best particle separation at the required temperature (20°C). Particles will band at points across the tube diameter where the sketched lines intersect this curve (lower axis) at equilibrium during centrifugation. After centrifugation the bands will reorient (upper axis).

3. Note the run speed and homogeneous CsCl concentration for the selected curve.

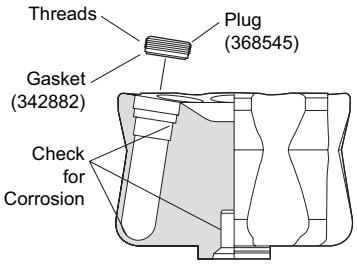
In this example, the 1.60-g/mL, 100 000-rpm curves in Figure 3 give the best separation. The separation is located at the center of the tube, the particles banding about 1 mm apart at equilibrium during centrifugation (the lower axis). However, referring to Figure 2, a 1.60-g/mL CsCl solution can only be run at 20°C in the TLN-100 rotor. If a 4°C run is required, the speed must be reduced to 90 000 rpm.

CARE AND MAINTENANCE

MAINTENANCE

NOTE

Do not use sharp tools on the rotor that could cause scratches in the rotor surface. Corrosion begins in scratches and may open fissures in the rotor with continued use.



- Regularly lubricate the metal threads in the rotor plugs with a thin, even coat of Spinkote lubricant. Failure to keep these threads lubricated can result in damaged threads. Replace rotor plugs (as a set) if they show signs of wear.

- Inspect plug gaskets for wear or damage. Replace as required. To remove the old gasket, squeeze it with your thumb and first finger until it comes away from the groove. Slip it off and snap a new one in its place. Be careful not to scratch the anodized surface of the plugs.

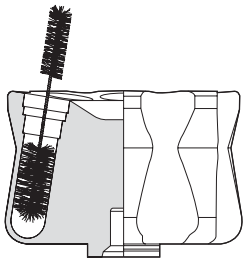
Refer to Appendix A in *Rotors and Tubes* for the chemical resistances of rotor and accessory materials. Your Beckman Coulter representative provides contact with the Field Rotor Inspection Program and the rotor repair center.

CLEANING

Wash the rotor and rotor components immediately if salts or other corrosive materials are used or if spillage has occurred. Do not allow corrosive materials to dry on the rotor.

Under normal use, wash the rotor frequently (at least weekly) to prevent buildup of residues.

1. Wash the rotor, plugs, and spacers in a mild detergent, such as Beckman Solution 555™ (339555), that won't damage the rotor. The Rotor Cleaning Kit contains two plastic-coated brushes and two quarts of Solution 555 for use with rotors and accessories. Dilute the detergent 10 to 1 with water.

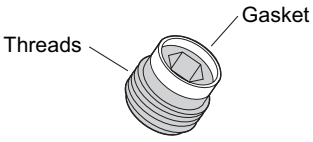


NOTE

Do not wash rotor components in a dishwasher. Do not soak in detergent solution for long periods, such as overnight.

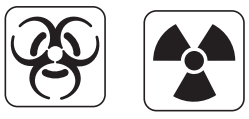
2. Rinse the cleaned rotor and components with distilled water.

3. Air-dry the rotor upside down. *Do not use acetone to dry the rotor.*



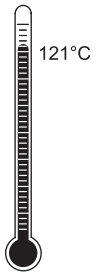
Clean plug threads as necessary. Use a brush and concentrated Solution 555. Rinse and dry thoroughly, then lubricate lightly but evenly with Spinkote to coat all threads.

DECONTAMINATION



If the rotor or other components are contaminated with radioactive, toxic, or pathogenic materials, follow appropriate decontamination procedures as outlined by appropriate laboratory safety guidelines and/or other regulations. Consult Appendix A in *Rotors and Tubes* to select an agent that will not damage the rotor.

STERILIZATION AND DISINFECTION



- The rotor and all rotor components can be autoclaved at 121°C for up to an hour. Remove the plugs and place the rotor and plugs in the autoclave upside down.
- Ethanol (70%)* or hydrogen peroxide (6%) may be used on all rotor components, including those made of plastic. Bleach (sodium hypochlorite) may be used, but may cause discoloration of anodized surfaces. Use the minimum immersion time for each solution, per laboratory standards.

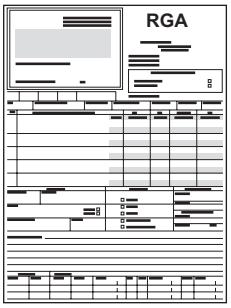
While Beckman Coulter has tested these methods and found that they do not damage the rotor or components, no guarantee of sterility or disinfection is expressed or implied. When sterilization or disinfection is a concern, consult your laboratory safety officer regarding proper methods to use.

STORAGE

When it is not in use, store the rotor in a dry environment (not in the instrument) with the plugs removed to allow air circulation so moisture will not collect in the tube cavities.

* Flammability hazard. Do not use in or near operating ultracentrifuges.

RETURNING A ROTOR



Before returning a rotor or accessory for any reason, prior permission (a Returned Goods Authorization form) must be obtained from Beckman Coulter, Inc. This RGA form may be obtained from your local Beckman Coulter sales office, and should contain the following information:

- serial number,
- history of use (approximate frequency of use),
- reason for the return,
- original purchase order number, billing number, and shipping number, if possible,
- name and phone number of the person to be notified upon receipt of the rotor or accessory at the factory,
- name and phone number of the person to be notified about repair costs, etc.

To protect our personnel, it is the customer's responsibility to ensure that all parts are free from pathogens and/or radioactivity. Sterilization and decontamination must be done before returning the parts. Smaller items (such as tubes, bottles, etc.) should be enclosed in a sealed plastic bag.

All parts must be accompanied by a note, plainly visible on the outside of the box or bag, stating that they are safe to handle and that they are not contaminated with pathogens or radioactivity. ***Failure to attach this notification will result in return or disposal of the items without review of the reported problem.***

Use the address label printed on the RGA form when mailing the rotor and/or accessories to:

Beckman Coulter, Inc.
1050 Page Mill Road
Palo Alto, CA 94304

Attention: Returned Goods

Customers located outside the United States should contact their local Beckman Coulter office.

SUPPLY LIST

NOTE

Publications referenced in this manual can be obtained by calling Beckman Coulter at 1-800-742-2345 in the United States, or by contacting your local Beckman Coulter office.

Contact Beckman Coulter Sales (1-800-742-2345 in the United States; worldwide offices are listed on the back cover of this manual) or see the Beckman Coulter *Ultracentrifuge Rotors, Tubes & Accessories* catalog (BR-8101) for detailed information on ordering parts and supplies. For your convenience, a partial list is given below.

REPLACEMENT ROTOR PARTS

TLN-100 rotor assembly	357614
Rotor plug (does not include gasket)	368545
Plug gasket (OD 14.5 mm; 0.57 in.)	342882
Cap and plunger assembly	349339
Rotor vise	347373

OTHER

Tubes and accessories	see Table 1
Quick-Seal Cordless Tube Topper kit, 60 Hz	358312
Quick-Seal Cordless Tube Topper kit, 50 Hz (Europe)	358313
Quick-Seal Cordless Tube Topper kit, 50 Hz (Great Britain)	358314
Quick-Seal Cordless Tube Topper kit, 50 Hz (Australia)	358315
Quick-Seal Cordless Tube Topper kit, 50-Hz (Canada)	367803
Tube Topper rack	355872
OptiSeal tube rack assembly	361650
Torque wrench	858121
Plug adapter	976959
Tube removal tool	361668
Curved hemostat (6-in.)	927208
Straight hemostat (6-in.)	961519
Fraction Recovery System	342025
Fraction Recovery System Adapter Kit for TL-series tubes	347828
Beckman Coulter CentriTube Slicer	347960
CentriTube Slicer replacement blades (pkg of 10)	348299
CentriTube Slicer adapter (for 13-mm tubes)	354526
Spinkote lubricant (2 oz)	306812

Silicone vacuum grease (1 oz)	335148
Rotor Cleaning Kit	339558
Rotor cleaning brush	347404
Beckman Solution 555 (1 qt)	339555

ULTRACENTRIFUGE ROTOR WARRANTY

All Beckman Coulter ultracentrifuge Fixed Angle, Vertical Tube, Near Vertical Tube, Swinging Bucket, and Airfuge rotors are warranted against defects in materials or workmanship for the time periods indicated below, subject to the Warranty Conditions stated below.

Preparative Ultracentrifuge Rotors . . . . . 5 years — No Proration

Analytical Ultracentrifuge Rotors. . . . . 5 years — No Proration

ML and TL Series Ultracentrifuge Rotors . . . . . 5 years — No Proration

Airfuge Ultracentrifuge Rotors. . . . . 1 year — No Proration

For Zonal, Continuous Flow, Component Test, and Rock Core ultracentrifuge rotors, see separate warranty.

Warranty Conditions (as applicable)

1) This warranty is valid for the time periods indicated above from the date of shipment to the original Buyer by Beckman Coulter or an authorized Beckman Coulter representative.

2) This warranty extends only to the original Buyer and may not be assigned or extended to a third person without written consent of Beckman Coulter.

3) This warranty covers the Beckman Coulter Centrifuge Systems only (including but not limited to the centrifuge, rotor, and accessories) and Beckman Coulter shall not be liable for damage to or loss of the user's sample, non-Beckman Coulter tubes, adapters, or other rotor contents.

4) This warranty is void if the Beckman Coulter Centrifuge System is determined by Beckman Coulter to have been operated or maintained in a manner contrary to the instructions in the operator's manual(s) for the Beckman Coulter Centrifuge System components in use. This includes but is not limited to operator misuse, abuse, or negligence regarding indicated maintenance procedures, centrifuge and rotor classification requirements, proper speed reduction for the high density of certain fluids, tubes, and tube caps, speed reduction for precipitating gradient materials, and speed reduction for high-temperature operation.

5) Rotor bucket sets purchased concurrently with or subsequent to the purchase of a Swinging Bucket Rotor are warranted only for a term co-extensive with that of the rotor for which the bucket sets are purchased.

6) This warranty does not cover the failure of a Beckman Coulter rotor in a centrifuge not of Beckman Coulter manufacture, or if the rotor is used in a Beckman Coulter centrifuge that has been modified without the written permission of Beckman Coulter, or is used with carriers, buckets, belts, or other devices not of Beckman Coulter manufacture.

7) Rotor parts subject to wear, including but not limited to rotor O-rings, VTi, NVT™, TLV, MLN, and TLN rotor tube cavity plugs and gaskets, tubing, tools, optical overspeed disks, bearings, seals, and lubrication are excluded from this warranty and should be frequently inspected and replaced if they become worn or damaged.

8) Keeping a rotor log is not mandatory, but may be desirable for maintenance of good laboratory practices.

Repair and Replacement Policies

1) If a Beckman Coulter rotor is determined by Beckman Coulter to be defective, Beckman Coulter will repair or replace it, subject to the Warranty Conditions. A replacement rotor will be warranted for the time remaining on the original rotor's warranty.

2) If a Beckman Coulter centrifuge is damaged due to a failure of a rotor covered by this warranty, Beckman Coulter will supply free of charge (i) all centrifuge parts required for repair (except the drive unit, which will be replaced at the then current price less a credit determined by the total number of revolutions or years completed, provided that such a unit was manufactured or rebuilt by Beckman Coulter), and (ii) if the centrifuge is currently covered by a Beckman Coulter warranty or Full Service Agreement, all labor necessary for repair of the centrifuge.

3) If a Beckman Coulter rotor covered by this warranty is damaged due to a malfunction of a Beckman Coulter ultracentrifuge covered by an Ultracentrifuge System Service Agreement, Beckman Coulter will repair or replace the rotor free of charge.

4) If a Beckman Coulter rotor covered by this warranty is damaged due to a failure of a Beckman Coulter tube, bottle, tube cap, spacer, or adapter, covered under the Conditions of this Warranty, Beckman Coulter will repair or replace the rotor and repair the instrument as per the conditions in policy point (2) above, and the replacement policy.

5) Damage to a Beckman Coulter rotor or instrument due to the failure or malfunction of a non-Beckman Coulter tube, bottle, tube cap, spacer, or adapter is not covered under this warranty, although Beckman Coulter will assist in seeking compensation under the manufacturer's warranty.

Disclaimer

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND BECKMAN COULTER, INC. SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND WHATSOEVER ARISING OUT OF THE MANUFACTURE, USE, SALE, HANDLING, REPAIR, MAINTENANCE, OR REPLACEMENT OF THE PRODUCT.

Factory Rotor Inspection Service

Beckman Coulter, Inc., will provide free mechanical and metallurgical inspection in Palo Alto, California, USA, of any Beckman Coulter rotor at the request of the user. (Shipping charges to Beckman Coulter are the responsibility of the user.) Rotors will be inspected in the user's laboratory if the centrifuge in which they are used is covered by an appropriate Beckman Coulter Service Agreement. Contact your local Beckman Coulter office for details of service coverage or cost.

Before shipping, contact the nearest Beckman Coulter Sales and Service office and request a Returned Goods Authorization (RGA) form and packaging instructions. Please include the complete rotor assembly, with buckets, lid, handle, tube cavity caps, etc. A SIGNED STATEMENT THAT THE ROTOR AND ACCESSORIES ARE NON-RADIOACTIVE, NON-PATHOGENIC, NON-TOXIC, AND OTHERWISE SAFE TO SHIP AND HANDLE IS REQUIRED.

Beckman Coulter Worldwide Biomedical Research Division Offices

AUSTRALIA
Beckman Coulter Australia Pty Ltd
Unit D, 24 College St.
Gladesville, NSW 2111
Australia
Telephone: (61) 2 9844-6000
or toll free: 1 800 060 880
Fax: (61) 2 9844-6096
email: lifescienceaustralia@beckman.com

CANADA
Beckman Coulter (Canada) Inc.
6755 Mississauga Road, Suite 600
Mississauga, Ontario
Canada L5N 7Y2
Telephone: (1) 905 819-1234
Fax: (1) 905 819-1485

CZECH REPUBLIC
Beckman Coulter Prague
Radiova 1
102 27 Prague 10
Czech Republice
Telephone: (420) 267 00 85 13
Fax: (420) 267 00 83 23

CHINA
Beckman Coulter Inc.
Beijing Representative Office
Unit 2005A, 2006-2009, East Ocean Center
Jian Guomenwai Avenue
Beijing 100004
China
Telephone: (86) 10 6515 6028
Fax: (86) 10 6515 6025, 6515 6026

EASTERN EUROPE/
MIDDLE EAST/NORTH AFRICA
Beckman Coulter International S.A.
22, Rue Juste-Olivier
Case Postale 301-303
CH-1260 Nyon, Switzerland
Telephone: (41) 22 365 3707
Fax: (41) 22 365 0700

FRANCE
Beckman Coulter France S.A.
Paris Nord II, 33/66 rue des Vanesses
B.P. 50359
Villepinte, France
95942 ROISSY CDG Cedex
Telephone: (33) 1 49 90 90 00
Fax: (33) 1 49 90 90 10
e-mail: bioresearch.france@beckman.com

GERMANY
Beckman Coulter GmbH
Europark Fichtenhain B-13
47807 Krefeld
Germany
Telephone: (49) 21 51 33 35
Fax: (49) 21 51 33 33
e-mail: bioresearch.de@beckman.com

HONG KONG
Beckman Coulter Hong Kong Ltd.
12th Floor, Oxford House
979 King's Road
Taikoo Place, Hong Kong
Telephone: (852) 2814 7431
Fax: (852) 2873 4511

INDIA
Beckman Coulter India Pvt. Ltd.
Solitaire Corporate Park
3rd Floor - Bldg. 11
Andheri Ghatkopar Link Road
Chakala, Andheri West
Mumbai India 400 098
Telephone: (91) 22 3080 5101

ITALY
Beckman Coulter S.p.a.
Centro Direzionale Lombardo
Palazzo F/1, Via Roma 108
20060 Cassina de' Pecchi
Milano, Italy
Telephone: (39) 02 953921
Fax: (39) 02 95392264

JAPAN
Beckman Coulter K.K.
TOC Ariake West Tower
2-5-7, Ariake, Koto-ku
Tokyo 135-0063 Japan
Telephone: (81) 3 5530 8500
Fax: (81) 3 5404 8436

MEXICO
Beckman Coulter de Mexico S.A. de C.V.
Avenida Popocatépetl #396
Colonia Gral. Pedro Maria Anaya
Codigo Postal 03340
Mexico, D.F. Mexico
Telephone: (001) 52-55-9183-2800

NETHERLANDS
Beckman Coulter Nederland B.V.
Nijverheidsweg 21
3641 RP-Mijdrecht
Postbus 47
3640 AA Mijdrecht
The Netherlands
Telephone: (31) 297-230630
Fax: (31) 297-288082

SINGAPORE
Beckman Coulter Singapore Pte. Ltd.
116 Changi Road
Unit #03-01/02
Singapore 419718
Telephone: (65) 6339 3633
Fax: (65) 6336 6303

SOUTH AFRICA/SUB-SAHARAN AFRICA
Beckman Coulter
Stand 1A Primegro Park
Tonetti Street
1685 Halfway House
Johannesburg
Republic of South Africa
Telephone: (27) 11-805-2014/5
Fax: (27) 11-805-4120
e-mail: beckman@intekom.co.za

SPAIN
Beckman Coulter España S.A.
C/ Caleruega, 81
28033 Madrid, Spain
Telephone: (34) 91 3836080
Fax: (34) 91 3836096
email: bioresearch.espana@beckman.com

SWEDEN
Beckman Coulter AB
Archimedesvaegen 7
Box 111 56
SE-168 11 Bromma
Sweden
Telephone: (46) 8 564 85 900
Telefax: (46) 8 564 85 901

SWITZERLAND
Beckman Coulter International S.A.
22, Rue Juste-Olivier
Case Postale 301-303
CH-1260 Nyon
Switzerland
Telephone: (41) 0800 850 810
Fax: (41) 0848 850 810

TAIWAN
Beckman Coulter Taiwan Inc.
Taiwan Branch
8th Floor
216 Tun Hwa South Road, Section 2
Taipei 106, Taiwan
Republic of China
Telephone: (886) 2 2378 3456
Fax: (886) 2 2377 0408

TURKEY
Beckman Coulter Ltd.
E-5 Yanyol Faith Cad.
81410 Soganlik Kartal
Istanbul
Turkey
Telephone: (90) 216 309 1900
Fax: (90) 216 309 0090

UNITED KINGDOM
Beckman Coulter United Kingdom Ltd
Oakley Court
Kingsmead Business Park
London Road
High Wycombe
Buckinghamshire HP11 1JU
England, U.K.
Telephone: (44) 01494 441181
Fax: (44) 01494 447558
e-mail: beckman_uk@beckman.com

Additional addresses are available at www.beckmancoulter.com.

BECKMAN COULTER®

Beckman Coulter, Inc. • 4300 N. Harbor Boulevard, Box 3100 • Fullerton, California 92834-3100
Sales and Service: 1-800-742-2345 • Internet: www.beckmancoulter.com • Telex: 678413 • Fax: 1-800-643-4366

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